Dr. Paul-Boncour's task is limited to a systematic study of the cranium, the facial part of the cranium, and the head of the living; his volume gives an accurate reflection of the methods and conclusions of the French school of anthropologists. The nature of his book is best indicated by a bare recitation of the subject-matter of its chapters.

The volume commences with a discussion on the growth and evolution of the skull, and then passes on to a description of its various parts. The succeeding chapters are devoted to the formation of the cranial cavity, to the methods of measurement and estimation of indices and of angles. The mandible and brain cavity are the subject-matter of special chapters. The second part—the more valuable—is devoted to the methods employed in registering the racial and individual characters as seen in living people—the form of the head, the development of muscles, the colour of the skin, the shape of the eyes, contour of the nose, form of ear, mouth, hair, and chin.

Dr. Paul-Boncour's volume is a simple, explicit, and methodical presentment of methods and opinions which have been perfected by the three generations of men who have made Paris the Mecca of anthropologists.

Science of the Sea. Edited by Dr. G. Herbert Fowler. Pp. xviii + 452. (London: John Murray, 1912.) Price 6*s*. net.

THERE is a large though scattered body of people interested in oceanography or fascinated by marine biology, but prevented from making any advance by the want of practical direction and assistance: not only explorers and yachtsmen, but officers in the Navy with time on their hands in port or in foreign stations, medical officers on board ship or on coastal stations, and gentlemen who have retired from active service. To all such who wish to learn the methods of oceanographic inquiry, this book will be gladly welcomed, for it brings together instructions that otherwise are hard to find, given with the greatest care, and tested by the practical experience of many lives. The handbook is, in fact, the collective wisdom of the most active members of the Challenger Society, a body that has met quarterly in an unobtrusive fashion in London for some years, and now expresses its interest in oceanographic research by this publication.

The book begins with a chapter on meteorology by Dr. Mill and Capt. Wilson Barker, whose names, like those of the succeeding contributors, are guarantees of soundness and fulness of knowledge, and then proceeds to a well-illustrated account of hydrography, the joint work of Prof. H. N. Dickson and Mr. D. J. Matthews, of Plymouth. A very interesting and practically helpful account of tropical shore-collecting and outfit is given by Prof. Stanley Gardiner, whose methods, with a little adaptation, are applicable to similar work in temperate seas. Then follow four chapters on marine biology, including one by Sir John Murray on oceanic deposits and the organisms of the seafloor. Fishing, whaling, and sealing are referred to in a rather summary fashion. Finally, the editor gives valuable counsel on methods of note-taking, whilst yacht-equipment, dredging, trawling, and the preservation of specimens are dealt with in a most helpful manner by the Director of the Marine Biological Association and others.

We congratulate the editor, Dr. Fowler, on the manner in which he has correlated and brought together such a valuable elementary compendium, and we can recommend this handbook as a trustworthy and practical guide to travellers, and not less a book of great interest to all biologists. F. W. G.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Practical Mathematics.

I WAS particularly sorry to be absent from the meetings of the International Mathematical Congress at Cambridge, because an address was expected from me upon the teaching of practical mathematics, and because Sir Wm. White, in his address on the relation of mathematics to engineering practice, referred to practical mathematics in a most contemptuous way.

Twenty years ago mathematics continued to be taught in what may be called the orthodox way, a way that succeeded fairly well with students who were fond of abstract reasoning, 3 per cent. of all students, and quite failed with the other 97 per cent. At the British Association discussion of 1901 (verbatim report published by Messrs. Macmillan), most of the great mathematicians and teachers of mathematics spoke or sent remarks in writing. In opening that discussion, I published my proposed Science and Art Department syllabus on practical mathematics. There was essential agreement with my views; there was scarcely one dissentient remark. A committee was formed, and recommended methods of teaching which are now extensively adopted. It is perhaps a pity that I gave such a misleading name as practical mathematics to the reformed methods, but I wanted to differentiate them from the orthodox methods of twenty years ago, and I did not dream that the new methods would be adopted so quickly. They are in use now in all the public schools where natural science is taught; they are in use in all science colleges and in all engineering colleges.

In evening schools it used to be that when a class of thirty apprentices was started in elementary mathematics, the attendance dwindled to ten in November, and in May it was usual to find only one or two faithful students. Now, in such schools, there is almost no teaching of the kind we used to call orthodox, but some hundred thousand apprentices study practical mathematics. The class of thirty formed in September remains in good attendance all the winter, and remains an excited and interested class of thirty in May. The new method suits the boy of great mathematical promise, but it is really arranged to give the average boy a love for computation and the power to use mathematical reasoning with pleasure and certainty. It recognises that every boy, every man, already possesses the fundamental notion of the infinitesimal calculus, and that it is quite easy

© 1912 Nature Publishing Group

to develop this notion so that he can use the methods of the calculus in his reasoning and computation. The subject was first recognised by the Science and Art Department in 1899; the number of students has increased year by year by the compound interest law, and it is now the most important science subject of the Board of Education.

When I was appointed professor of mathematics and mechanics, seventeen years ago, at the Royal College of Science, it was known that I would adopt that experimental method of teaching mechanics and applied mechanics and engineering science with which my name had become identified at the Finsbury College of the City Guilds. It is the method now in use in nearly all polytechnics and engineering colleges. It went hand in hand with the practical mathematics which it was also understood that I should establish at Kensington. My books describing these methods have been translated into many languages, and the methods have been largely adopted in America, Germany, and other foreign countries. Much of my time has been spent in showing foreign visitors how my methods of teaching were carried out in practice.

I feel sure that few of the men listening to Sir Wm. White, even of the foreigners, were ignorant of these facts. It is known that the most elementary class at the college, attendance at which is compulsory on all students of the Royal School of Mines and the chemical and other students, was taught on the lines laid down for all evening classes in practical mathematics, the work being made interesting for the average student, and including the elementary methods of the calculus. Not only here, but in the very highest mathematical work of the college, a competent person will see that the study is exceedingly different from what used to be the study of the mere mathematician on the same subjects. All our syllabuses and methods of teaching have been highly praised by most eminent judges, like the late Lord Kelvin, and they are now in no way different from what they were seventeen years ago.

According to the report in *The Times*, Sir Wm. White said that in the teaching of engineering students, some authorities now favoured special courses in practical mathematics; others believed that engineers should be taught by professional mathematicians because this method must lead to broader views and greater capacity for original investigation. His experience led him to rank himself with the supporters of the latter, and he said that this view is now adopted at the Imperial College of Science and Technology.

I know that Sir William contemplates great changes at the Imperial College, and no doubt great changes will rapidly take place, as I have been asked to retire, and Prof. Henrici has already retired. An attempt will, no doubt, be made to give up those methods to which I gave the misleading name practical mathematics, and in all probability the places of Prof. Henrici and myself will be taken by more orthodox persons. It is also probable that a "professional mathematician" will be put in charge of the teaching of mechanics. As I am still on the staff of the college I do not think that I can criticise the actions of the governing body. It is, however, my duty to deny a hurtful statement about my own department, and to oppose what I consider to be a wrong opinion, expressed at a public meeting by one of the forty members of the governing body.

I wish to observe that no change has yet been made. The syllabus and methods of teaching are exactly as they have been for seventeen years, and when Sir William says that his view is now adopted at the Imperial College he really means that he himself has adopted this view.

This is a most important matter. Sir William White's remarks may influence the action of the governing bodies of the other engineering colleges of the country. In England, if a man is a great lawyer it is assumed that his views about Tibet must be right; if he is a great chemist it is held that his views about women's suffrage must not be disputed; and if he is a great designer of ships it is assumed that he is an authority on technical education.

It used to be that colleges were governed by a council of the professors, but now the opinions of the professors are of no account, and the staff dare not even suggest to the governors that it is possible for honest, sensible, diligent, self-sacrificing shopkeepers, merchants, and manufacturers to be so misled that they may ruin technical education for the next ten years. Such ruin will only be temporary, it is true, but when I think of our competition with the foreigner I look with great dismay on the possibility that Sir William White's opinions may have too much weight with the persons who have charge of technical education.

The old engineering college did not compel its students to have more than the most elementary mathematical knowledge, because only civil engineering was taught, and the average civil engineer needs no mathematics. When mechanical engineering and shipbuilding students began to be taught, the mathematics standard was only slightly raised. But modern high-speed machinery has made it necessary for mechanical engineers to understand the effects of vibration, critical speeds of shafts, &c., and to pursue numerous studies which require a knowledge of higher mathematics even in the average student. And nowadays we have the electrical engineer requiring a knowledge of the methods of very advanced mathematics. Sir Wm. White thinks of the requirements of the civil engineer or shipbuilder of his youth; we teachers have to think of the requirements of the student of to-day. Now I affirm that the average student cannot be taught this necessary advanced work unless by the reformed methods. He cannot be carried beyond the most elementary things, and these he does not understand.

I have now expressed my opinion in regard to Sir William's remark about practical mathematics. In weighing our opinions it must be remembered that Sir William's practical experience as an engineer has been in naval architecture only, and as a teacher it lay also in naval architecture only, and a considerable time ago.

Sir William says that all the mathematical teaching of engineers should be by what he calls professional mathematicians, and he evidently means by this that these teachers shall not be engineers or men acquainted with engineering science. He means that they shall be mere mathematicians. Well, this has been tried often enough, and it has always been found that the one or two good students take a distaste to practical engineering, and the average student is never brought beyond the driest elementary work, and he hates the appearance of a mathematical symbol all his life after. The average student cannot understand abstract reasoning; his teacher has no knowledge of him, and pursues his serenely ignorant way, wondering how it is that so many students are stupid, or else he wonders that he and a few other men should be so supremely clever. He never studies his pupil. There are men who can train almost any animal; they study its habits of thought; they are kind and sympathetic. The poor average English boy is never studied by the professional mathematician.

John Perry.

Imperial College of Science and Technology,
September 2.

© 1912 Nature Publishing Group